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LOCALISM: A NEW ENDORSEMENT OF AN OLD PARADIGM FOR FLOOD FREQUENCY ESTIMATION

Thomas Kjeldsen

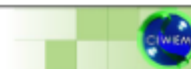
Department of Architecture and Civil Engineering

University of Bath

- Rationale of using local data
- General uncertainty assessment for FEH
- Constrain uncertainty on QMED using local data

“You keep saying the FEH methods work reasonably well across the UK, but how come they never work for my catchment?”

EA-SW hydrologist, 2011



How reliable are design flood estimates in the UK?

T.R. Kjeldsen

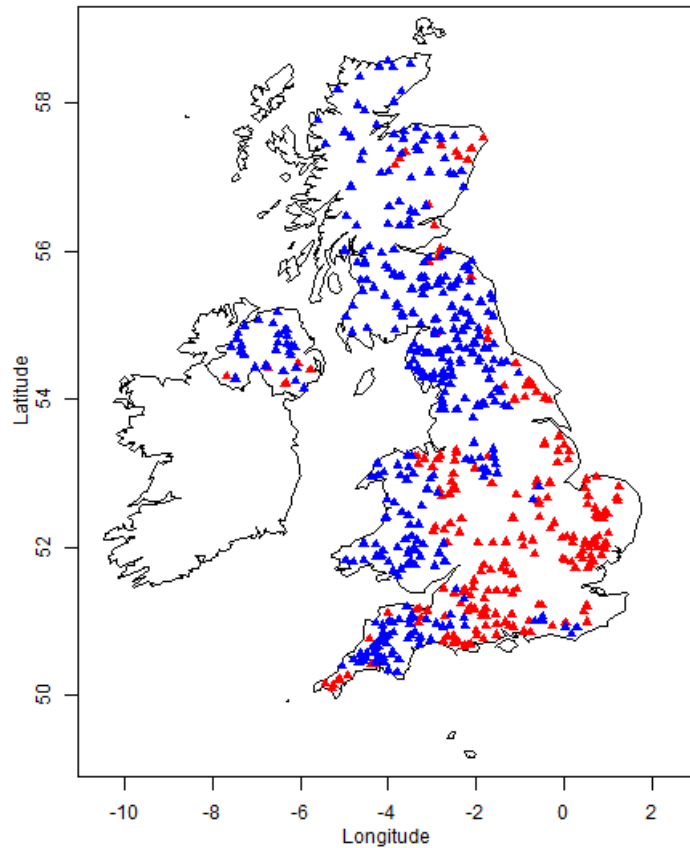
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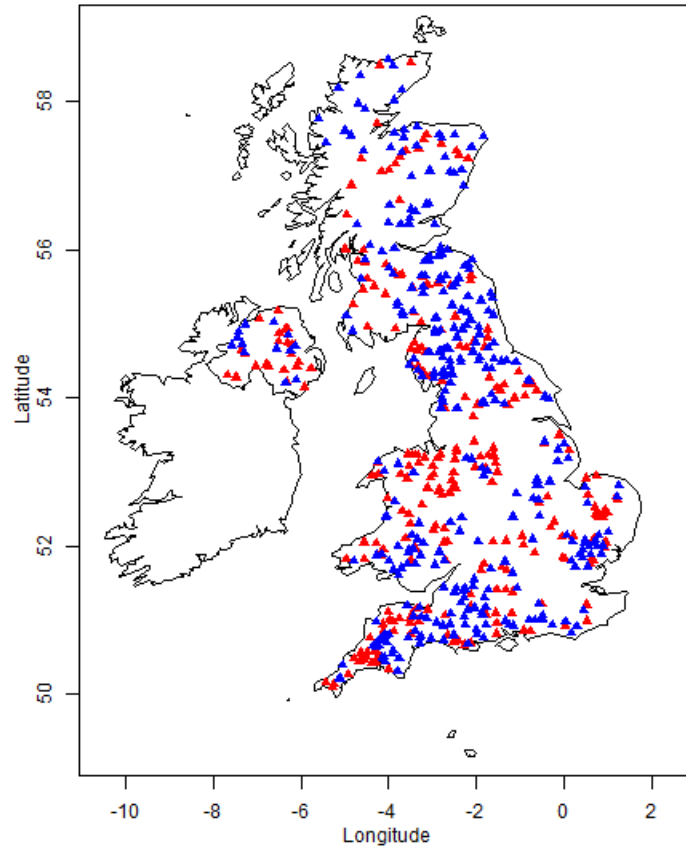
Abstract

Design flood estimates in the UK are routinely obtained by using the improved Flood Estimation Handbook (FEH) statistical procedure. This paper presents a practical framework for assessing the uncertainty associated with estimates of



Regression model using

- AREA



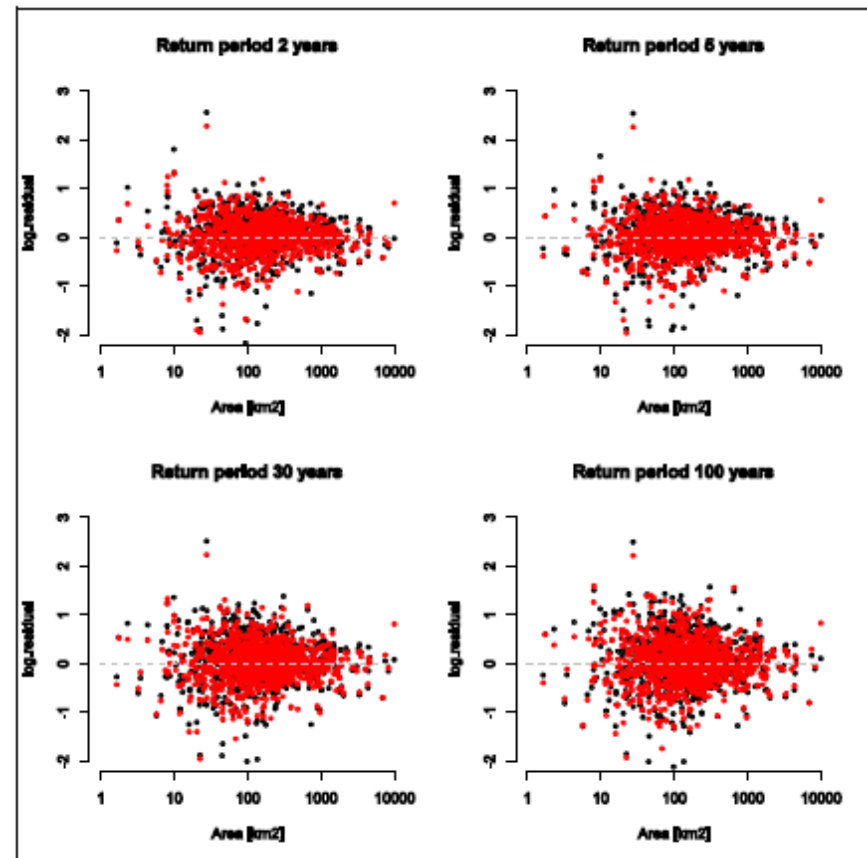
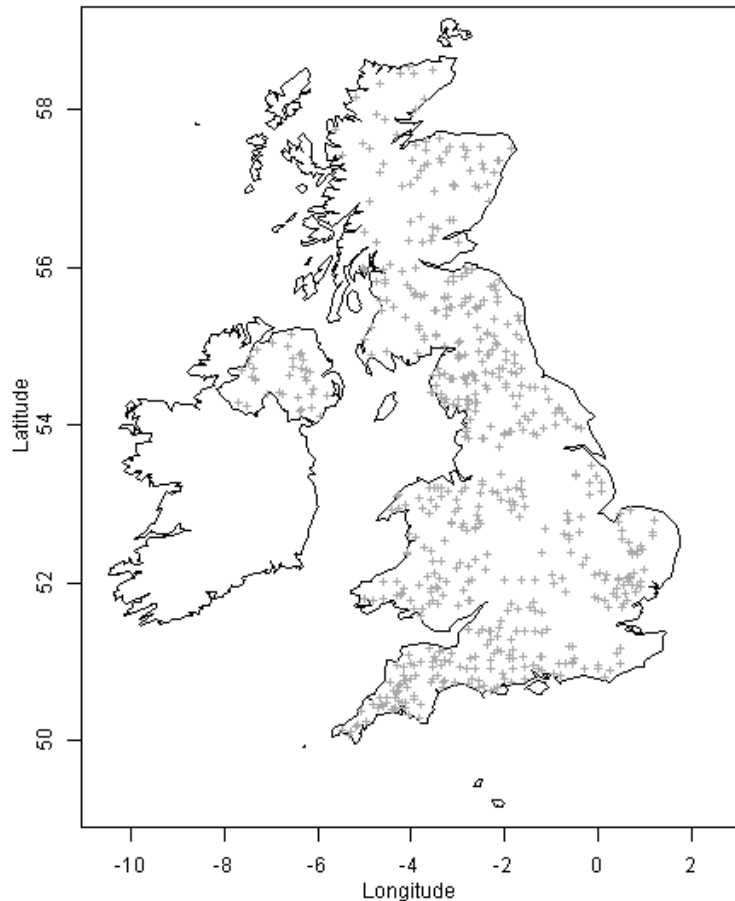
Regression model using

- AREA
- SAAR
- FARL
- BFIHOST

Characterise variability of
residuals across many sites

$$e = \ln \hat{Q}_T - \ln Q_T$$

- Estimate Q_T – no donor
- Estimate Q_T – use one donor



$$e = \ln \hat{Q}_T - \ln Q_T$$

$$fse = \exp \left[\sqrt{\frac{1}{m} \sum_{i=1}^m (\ln \hat{Q}_T - \ln Q_T)^2 - \frac{1}{m} \sum_{i=1}^m \text{Var}\{\ln Q_T\}} \right]$$

Return period	fse (regression only)	fse (regression + donor)
2	1.47	1.42
5	1.48	1.43
30	1.52	1.47
100	1.54	1.50

Return period	fse (regression only)	fse (regression + donor)
2	1.47	1.42
5	1.48	1.43
30	1.52	1.47
100	1.54	1.50

Use FEH to get a design flood: $Q_{100} = 10.0 \text{ m}^3/\text{s}$

68% confidence interval: $[10/1.50 ; 10 \cdot 1.50] = [6.7 ; 15.0] \text{ m}^3/\text{s}$

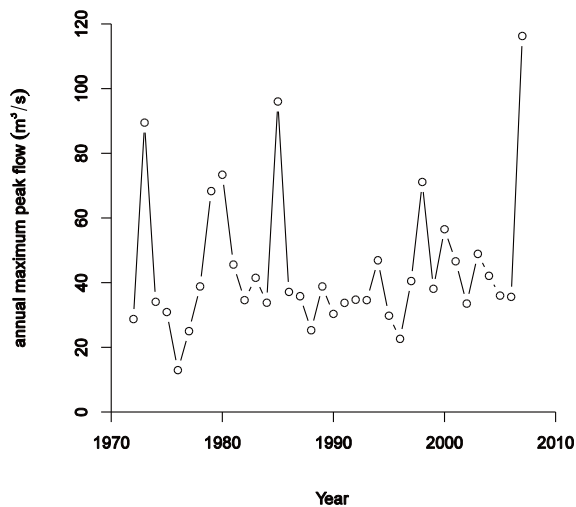
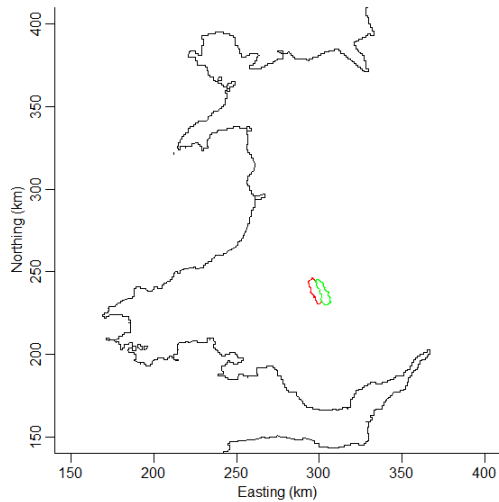
95% confidence interval: $[10/1.50^2 ; 10 \cdot 1.50^2] = [4.4 ; 22.5] \text{ m}^3/\text{s}$

Estimating uncertainty of QMED for a range of scenarios

Data availability	fse formula	
Ungauged site	$fse = \exp(\sqrt{0.1286})$	Ungauged
Ungauged + 1 donor	$fse^{\sqrt{1-a^2}}$	
Ungauged + many donors	$fse^{\sqrt{1-b^T \Omega^{-1} b}}$	
Gauged, but only just	$fse^{s_x(s_x^2+0.1431)^{-0.5}}$	Gauged
Gauged	$\exp(2\beta/\sqrt{n})$	
Gauged + historical data	???	

$$a = 0.4598 \exp(-0.020 d_{sg}) + (1 - 0.4598) \exp(-0.4785 d_{sg})$$

$$s_x = 2\beta/\sqrt{n}$$



Catchment descriptor	Subject site	Donor site
	56013	56003
Easting (cent) [m]	297622	302454
Northing (cent) [m]	238444	237136
AREA [km²]	63.27	62.5
SAAR [mm]	1299	1171
FARL [-]	1	0.999
BFIHOST [-]	0.494	0.528

Method	QMED (m³/s)	fse
Gauged (n = 36)	36.6	1.08
Regression only	31.6	1.43
Regression + donor transfer	31.3	1.37
Sparsely gauged case (n=5 years) + regression	39.4	1.10
Sparsely gauged case (n=5) without regression	42.1	1.20

Conclusions

- FEH very helpful where no data are available
- Uncertainty of design floods is very high
- Both FEH and local data can constrain the uncertainty
- Combine FEH with local data should be best practise
- Measures of uncertainty (fse) available for simple cases